

WHAT IS CLAIMED IS:

1. A process for producing a silica-based film which comprises irradiating a film comprising at least one siloxane compound with electron beams to thereby convert the film into a film having a dielectric constant of 3 or lower and having silicon carbide bonds represented by Si-C-Si.

2. The process as claimed in claim 1, wherein the silica-based film has a dielectric constant of 2.8 or lower.

3. The process as claimed in claim 1, wherein the siloxane compound is a product of the hydrolysis and/or condensation of at least one compound selected from the group consisting of compounds represented by the following formula (1) :



wherein R¹ represents a monovalent organic group or a hydrogen atom; R² represents a monovalent organic group; and a is an integer of 0 to 2,

and compounds represented by the following formula (2) :



wherein R³, R⁴, R⁵, and R⁶ may be the same or different and each represents a monovalent organic group; b and c may be the same or different and each is an integer of 0 to 2; R⁷ represents an oxygen atom or a group represented by -(CH₂)_n- , wherein n is 1 to 6; and d is 0 or 1.

4. The process as claimed in claim 1, wherein the film comprising a siloxane compound is an organic silica film.

5. The process as claimed in claim 1, wherein the film

comprising a siloxane compound has a thickness of from 0.05 to 3 μ m.

6. The process as claimed in claim 1, wherein the electron beam irradiation is conducted at an energy of from 0.1 to 50 keV in an irradiation dose of from 1 to 1,000 μ C/cm².

7. The process as claimed in claim 1, wherein the electron beam irradiation is conducted at 25 to 500°C.

8. The process as claimed in claim 1, wherein the electron beam irradiation is conducted in an atmosphere having an oxygen concentration of 10,000 ppm or lower.

9. The process as claimed in claim 1, wherein the electron beam irradiation is conducted in an inert gas atmosphere.

10. The process as claimed in claim 1, wherein the electron beam irradiation is conducted at 133.3 Pa or lower.

11. The process as claimed in claim 1, wherein the film comprising a siloxane compound is heat-cured at 300 to 500°C before being subjected to the electron beam irradiation.

12. A silica-based film obtained by the process as claimed in claim 1.

13. The silica-based film as claimed in claim 12, which has a carbon content of from 5 to 17% by mole.

14. A low-dielectric film comprising the silica-based film as claimed in claim 12.

15. A semiconductor device having the low-dielectric film as claimed in claim 14.